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Local heating of the wound with dressings soaked in saline at 42 °C can reduce postoperative bleeding: a single-blind, split-mouth, randomised controlled clinical trial

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Abstract

Control of bleeding is essential during oral procedures. Although various chemical agents have been introduced and tested, hot water dressing has not to our knowledge been assessed before. Studies of operations for epistaxis or sinus conditions have suggested that irrigation with hot water can reduce bleeding, so we hypothesised that it might be effective in reducing bleeding after extraction too. Ten patients who required bilateral extractions took part in this split-mouth, randomised, single-blind, controlled clinical trial. After extraction, sockets were packed with similar gauze dressings soaked in normal saline 4 ml at room temperature (control) and warmed to 42 °C (experimental). The extent of bleeding on each side was measured by subtracting the original weight of the gauze from its weight after absorption of blood. The difference between the weights was compared using Student's paired *t* test ($\alpha = 0.05$, $\beta < 0.05$). Mean (SD) weights were 22.1(2.2) g and 18.4 (2.5) g in the control and experimental groups, respectively, indicating an 18% reduction in the experimental group ($p = 0.002$). Soaking gauze in normal saline heated to 42 °C can reduce bleeding after extraction.

Keywords: Haemorrhage; Bleeding Control; Postextraction Complications; Haemostasis; Coagulation; Hot Water Irrigation

Introduction

Oral surgery can be followed by normal consequences such as bleeding, pain, or swelling as well as complications such as fracture and dry socket.[1,2] Although bleeding after surgical interventions is a normal phenomenon, it can be challenging and cause distress and discomfort to both the patient and surgeon.[3] Dentists are sometimes faced by patients prone to bleeding or clotting disorders,[4] which can hinder healing and necessitate continuous suction. This can add to the difficulty of the operation, and increase the duration. [5] Methods of controlling bleeding are therefore of clinical importance.

Bleeding can be controlled by pressing gauze on the area or by haemostatic agents,[1,6] which include antifibrinolytic mouthwashes containing tranexamic acid, gelatin sponges, oxidized cellulose, and microcrystalline collagen.[5–7] Some of these agents –such as vasoconstrictors or tranexamic acid– have adverse effects [5,8] or might be expensive. There might also be a potentially non-invasive, economical, and chemical-free method for controlling bleeding. By mechanisms not yet isolated, irrigation with hot water (about 42° to 50 °C) has been shown to reduce bleeding in patients with epistaxis or bleeding during operations on the sinus or adenoids.[5,8–12]

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Irrigation with saline at 40°–42° might reduce intracranial bleeding from minor vessels, and diffuse oozing from sinonasal mucosa.[8,13] In addition, decreasing the temperature progressively impairs the coagulation system.[14–16] We therefore hypothesised that hot water irrigation might provide good control of bleeding after oral operations.

To our knowledge, all previous studies about control of bleeding have been in anticoagulated patients.[5–7] This reduces their generalisability, as such patients make up a small proportion of our workload.

As far as we know the efficacy of exposure to hot water has not been assessed, either in anticoagulated or in normal patients, so we organised a randomised, split-mouth, clinical trial. Our null hypothesis was that there would be no difference between the amounts of blood collected from extraction sockets treated normally compared with those under pressure from warmed gauze. The specific aims of the study were: to find a group of healthy patients who needed bilateral extraction of identically-matched teeth, to extract those teeth in a single session, and to compare the extent of bleeding after extraction after packing the sites with dressings soaked in hot saline (42 °C) and dressings soaked in saline stored at room temperature.

Subjects and methods

This split-mouth, randomised, single-blind, controlled clinical trial was carried out on 20 bilateral extraction sockets in 10 patients who attended to the Department of Maxillofacial Surgery of the University in 2014. The sample size (10×2) was calculated to obtain test powers greater than 95% ($\alpha = 0.05$, $\beta < 0.05$).

The patients were enrolled voluntarily in the study, and had the design explained to them. They gave their signed written consent. The ethics of the study protocol were approved by the Research Committee of the University, according to the Helsinki declaration (thesis #24175).

The inclusion criterion was the need for extraction of bilateral teeth that were identical in health, position, and prognosis in an arch. The exclusion criteria were: systemic diseases, bleeding disorders, postoperative active arterial bleeding from the socket, or need for postoperative suturing. If the prognoses of both a patient's teeth were not identical that patient would also be excluded, as would patients who were given unequal numbers of carpules of anaesthetic on the two sides. We also tried to balance the sample in terms of the number of maxillary and mandibular extraction sockets.

The sole independent variable was the temperature of the dressings (normal compared with heated). The dependent variable was the extent of postoperative bleeding (g).

Data collection

Randomisation and blinding: the randomisation was done by a dentist using a table of random numbers. Both dentist and patients were aware of the experimental side, but the surgeon was unaware of the randomisation (hence, single-blind).

Operation: all the operations were done by a maxillofacial surgeon with about 17 years' experience. The surgeon removed both teeth from each patient in a single session. The order of the extraction sites (left or right) was selected randomly unless patients asked for or needed the removal of one side first. The patients were given local anaesthesia (lignocaine with 1:80000 epinephrine) to the inferior alveolar, long buccal, and lingual nerves in the mandible, and as local block (infiltration) on the buccal and palatal sides of the maxilla. The patient was given as many doses as requested/needed until the operation was comfortable on both sides.[2] Each patient had to have an equal number of carpules of anaesthetic on both sides to remain in the study.

The experiment: The experiments were done by the general dentist without the surgeon present, using cotton rolls. A sterile 8-layer $5 \times 5\ mm^2$ 100%-cottonwool gauze dressing was soaked completely in 20 ml of sterile normal saline stored at room temperature. It was then compressed manually so that only 4 ml remained in the gauze. The amount of saline was measured and confirmed to be 4 ml. The gauze was weighed, and then placed over the extraction wound. The patient bit on the gauze for one minute, and the socket was checked to see if it was still bleeding. This was repeated every minute with the same gauze until the bleeding stopped. Each time, the cotton rolls (not the dressings) were checked for traces of saliva and if necessary, replaced with fresh, dry rolls. If the bleeding did not stop within 15 minutes, the patient would be excluded. If the bleeding lasted less than 15 minutes the patient remained in the study and the amount of blood was weighed using a digital scale and the weight of the original gauze subtracted from it. None of the patients that we assessed bled for more than 5 minutes postoperatively. None of the cotton gauze dressings was contaminated with saliva.

After the bleeding had been controlled, the other side was gently cleaned and dried, and the other tooth extracted. The surgeon then left the room again while the dentist measured the bleeding. The experimental socket was bandaged with a similar gauze dressing. The experimental dressing was soaked in normal saline 4 ml warmed to 42 °C. The amount of saline was again assessed and confirmed as 4 ml. Bleeding was controlled in a way similar to the other side using a single gauze dressing.

Materials used on both the control and treatment sides were the sterile gauze dressings (one dressing/socket). The cotton rolls were not a part of the dressings nor were they wrapped in gauze. Rolls were pushed into the sulci and vestibules merely as protection measures against potential contamination with saliva. There were no postoperative complications.

Assessment of bleeding: The extent of bleeding was measured by subtracting the original weight of the gauze plus saline 4 ml from its weight after it had absorbed the blood. The sockets were isolated from salivation, during both the surgery and the experiment.

Table 1
Details of the patients studied.

Variable	Number
Sex:	
Male	3
Female	7
Mean (SD) age (years):	44 (15)
Range	25-66
Site of teeth (pairs):	
Maxilla	5
Mandible	5
Type of teeth (pairs):	
Central incisors	2
Lateral incisors	2
First premolars	1
Third molars	5

Table 2
Differences in the weight of the swabs (g). N = 10 in each group.

Measurement	Control	Experimental
Mean (SD)	23 (2)	18 (3)
Coefficient of variation (%)	10	13
Range	17-25	16-23
95% CI	20.7 to 23.4	16.9 to 19.9

Data analysis

The significance of differences in the amounts of bleeding on the two sides were assessed using a paired Student's *t* test of the SPSS program (version 20.0, IBM, USA). Probabilities of less than 0.05 were accepted as significant.

Results

The sample is described in Table 1. Sufficient local anaesthetic was given and maintained by using a single carpule of anaesthetic into each extraction site. All the variables were matched on the two sides as a result of the split-mouth nature of the study.

The mean weight of blood collected from the experimental alveoli was about 18% less than that collected from the control group ($p = 0.002$, Table 2).

Discussion

Our findings suggest for (we think) the first time that dressings soaked in hot water might reduce the amount of postoperative bleeding in oral surgery. As we know of no similar study, we are limited to discussing more general features of haemostasis and temperature. Haemostasis is a cascade of reacting platelets and enzymes, which are regulated by feedback mechanisms to lead to a balance between coagulation and fibrinolysis. The distortion of this balance might lead to excessive bleeding, or thromboembolism, or both.

Hypothermia might inhibit enzymatic reactions of the coagulation cascade and might impair platelet reactivity, prolong clotting times, and increase fibrinolytic activity.[15,17,18] It can also impair blood circulation by increasing blood viscosity and decreasing the velocity of capillary blood flow.[15,19] We deduce, therefore, that perhaps by increasing the temperature we might reverse the effect (potentially by increasing enzymatic activity).[20,21] It should be taken into account, though, that heating might increase blood flow and indirectly contribute to haemorrhage (which needs further investigation).

Higher focal temperatures such as 70 °C, can reduce bleeding by welding vessels,[20–22] though this is unlikely at 42 °C. Nasal irrigation with water at 40-44 °C and 46 °C causes little or no change in tissue. At 48 °C or over the veins start to dilate, and at higher temperatures the mucosa becomes oedematous and the intranasal lumen narrows. Only at 52 °C or higher are severe changes such as epithelial necrosis seen.[10] According to one study, irrigation with hot water at 50 °C might produce vasodilatation and oedema of the nasal mucosa without the risk of necrosis. This mucosal oedema results in local compression of the bleeding vessels while triggering and probably accelerating the clotting cascade.[5,23] Increases in temperature from 37° to 39 °C at pH 7.37 might not affect any thromboelastographic variables.[24]

Limitations and strengths of the study

This study was limited by some factors. Although each patient's teeth were clinically similar, the extraction time was not necessarily similar for the two sites. The length of time between the giving of the local anaesthetic with vasoconstrictor and the application of haemostatic packs should have been recorded and accounted for. It would also have been better to compare the time that bleeding stopped. In addition, the sample size was small, though it was chosen based on power calculations. Because we properly controlled the confounding variables, the current number of sockets sufficed. An excessively large sample would make the test overpowered, and increase the false positive error rate, which might not be desirable,[25] and enrolling an unsubstantiated and unnecessarily large number of patients into a clinical trial being conducted for the first time might not be ethical.

The generalisability of the study benefited from the wide range of ages, the enrollment of both sexes, including smokers, and the extraction of almost all types of teeth. Unlike previous studies on the efficacy of techniques of coagulation, we studied normal (not anticoagulated) patients. This improved the generalisability, as most people who attend our clinics are not patients with bleeding disorders. It might be argued that the level of bleeding might be affected by gravity, and so differ in maxillary and mandibular sockets. Nevertheless, even if gravity did contribute to the small amount of bleeding, it would affect both the control and experimental sockets in the same way in this split-mouth design.

We conclude that packing sockets with dressings soaked in warmed saline might result in less postoperative bleeding after extraction of teeth. Future studies are warranted to assess the effect of heated saline irrigation in controlling intraoperative bleeding.

Conflict of Interest

We have no conflict of interest.

Ethics statement/confirmation of patients' permission

No identifying information about patients has been published. The trial was approved by the Institutional Review Board according to the principles of the Helsinki declaration.

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